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Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

J250/10 Summer 2022 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

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Paper 10 series overview

J250/10 is the second of two higher papers assessing chemistry in the Combined Science A suite. The other four papers in the suite assess biology and physics. This paper assesses content from topics C4–C6 and CS7, with assumed knowledge of C1–C3. To do well on this paper, candidates need to be comfortable applying their knowledge and understanding to unfamiliar contexts and be familiar with a range of practical techniques. There is also an emphasis on knowledge and understanding of the assessment objectives from the specification.

It is important that candidates understand the command words and what is expected when a particular command word is used. In some cases, descriptions were given when explanations were needed and so not all marks were accessed. Exam practice is essential so that candidates understand the requirements of a paper. It is good to see that the candidates are reading the maths style questions correctly and recognising where specific number of decimal places or significant figures are needed. It is also good to see working shown when using and interpreting graphs.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• read the question carefully and used all information given • knew basic scientific principles and terminology and used them correctly • were able to interpret data from tables and graphs • were familiar with relevant practicals • understood the effect of controlling or changing variables in a practical • understood industrial electrolysis • were able to write half equations correctly • were able to use data correctly to perform calculations and show working, including giving answers to correct decimal places or significant figures • understood the factors that affect equilibrium	• did not read the questions carefully and did not use all the information provided • did not use correct terminology • struggled to interpret data from tables and graphs • were not familiar with practical techniques • did not understand the effect of controlling or changing variables in a practical • did not understand industrial electrolysis • could not write correct half equations • did not show working for calculation questions • could not explain the factors that affect equilibrium

Section A overview

It was good to see few candidates leaving any of the multiple-choice questions blank although guesswork was evident.

Questions 2, 6, 7 and 9, the majority got these correct.

For Question 4, and 8 slightly fewer got these correct. For Question 4, C was a common wrong answer and for Question 8, B was the common wrong answer.

For Question 1 the main error was A

Question 3 C was a common wrong answer.

Question 5 C was a common wrong answer. This may be because they did not read the question carefully and just described unheated crude oil

Question 10 – very few got this correct. B was the most common wrong answer.

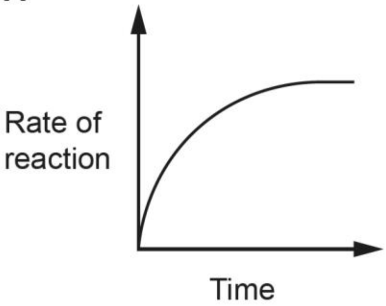
It is important that the question and all possible answers are read carefully.

Question 1

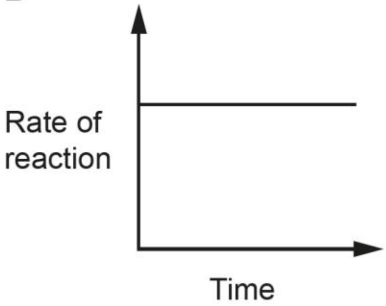
1 A student investigates the rate of reaction between magnesium and an excess of dilute sulfuric acid.

Which graph shows how the **rate of reaction** changes with time?

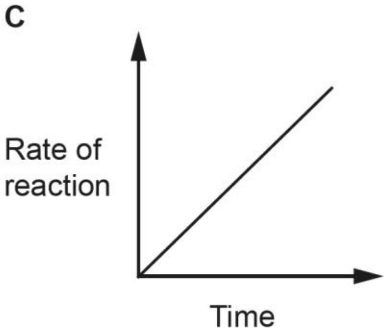
A



B



C



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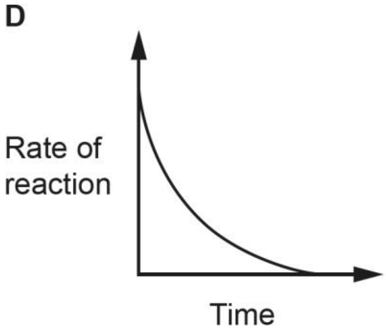


Your answer ☐ **[1]**

There were few correct responses here. Most candidates wrongly choose graph A. It is important to carefully read the labels on the axis. It is possible candidates thought these were rate of formation graphs as they may be very familiar with those.

Question 2

2 In the UK, one person produces about 9.5×10^3 kg of carbon dioxide per year.

One tree can take in 15 kg of carbon dioxide per year.

Approximately how many of these trees are needed to reduce one person's yearly carbon dioxide output to zero?

A 15

B 650

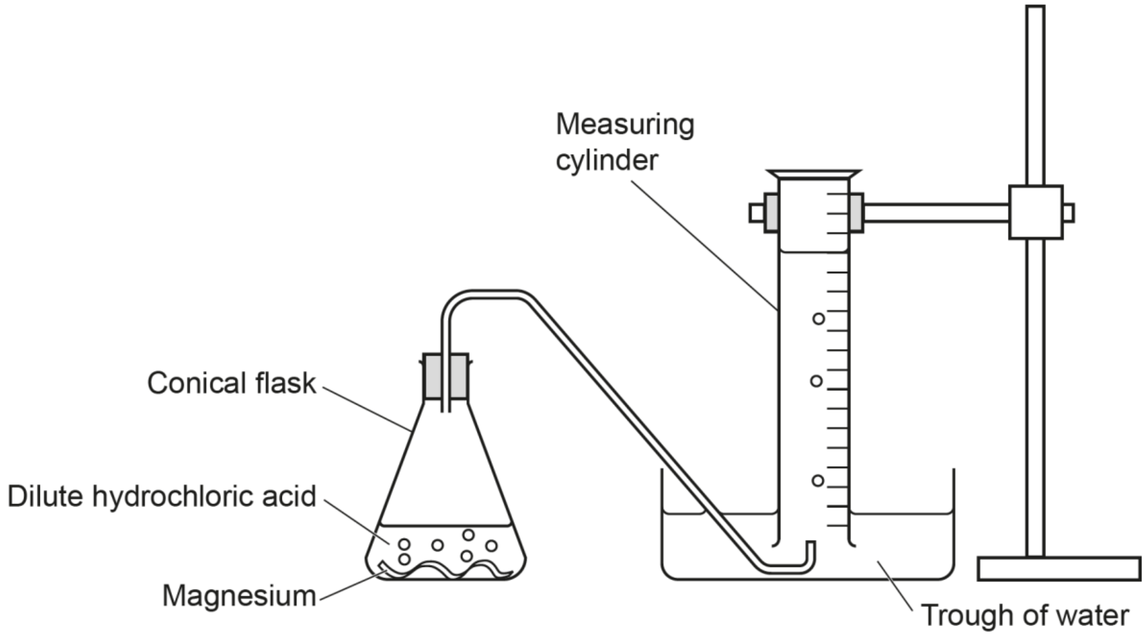
C 1600

D 140 000

Your answer [ ] **[1]**

Question 3

3 A student investigates the rate of reaction between magnesium and dilute hydrochloric acid.



Which piece of equipment could the student use instead of the measuring cylinder to produce more accurate results?

A Boiling tube

B Gas syringe

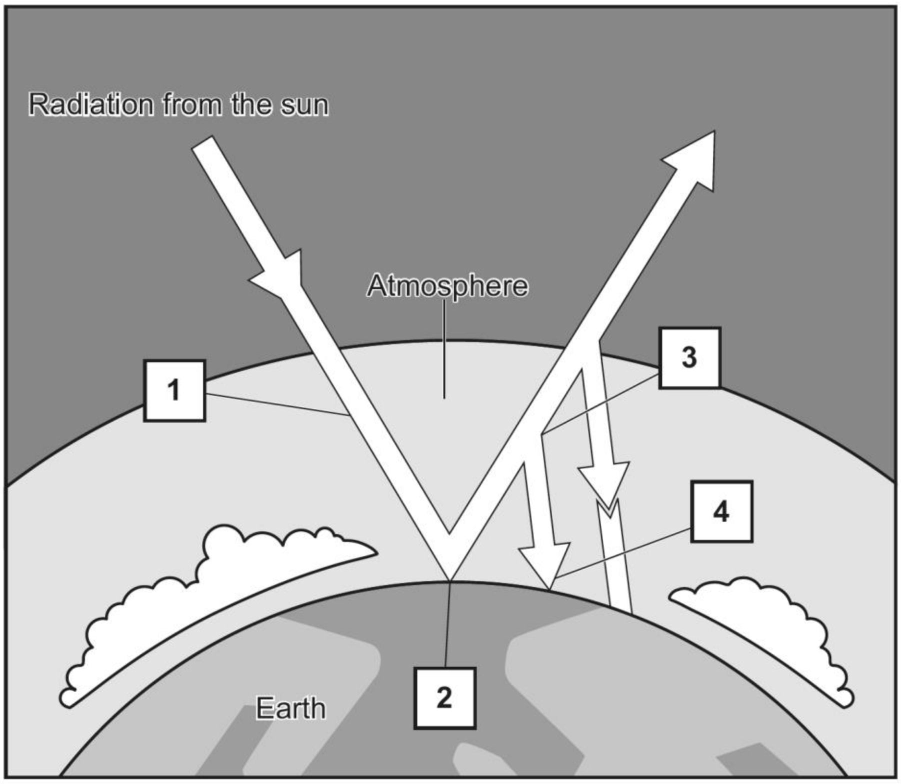
C Pipette

D Test tube

Your answer [ ] **[1]**

Question 4

4 The diagram shows the four processes, **1–4**, that cause the greenhouse effect.



Which process happens at **3**?

A Greenhouse gases absorb some infrared radiation.

B Infrared radiation is emitted by the Earth's surface.

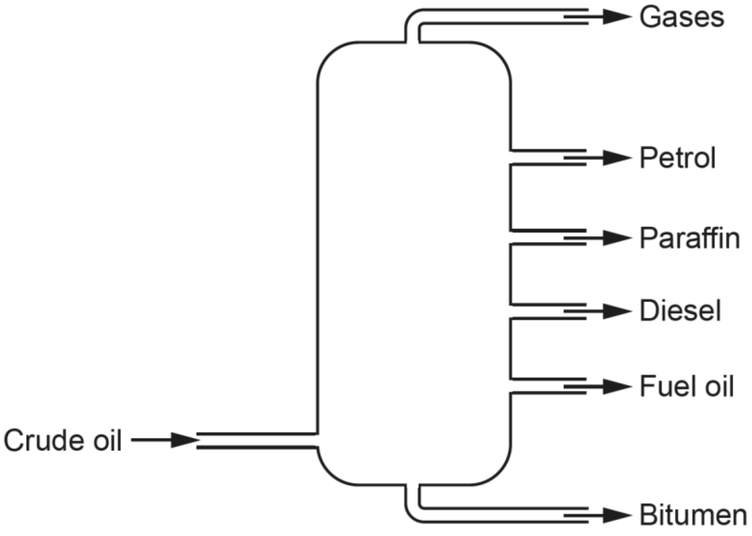
C Infrared radiation warms the Earth's surface.

D Radiation of all wavelengths passes through the atmosphere.

Your answer ☐ **[1]**

Question 5

5 The diagram shows how crude oil is separated into its fractions in a fractionating column.



What is the physical state of the crude oil as it enters the fractionating column?

A Aqueous

B Gas

C Liquid

D Solid

Your answer [1]

Most common incorrect answer was C. It is important for candidates to study any diagrams carefully to make sure they answer the question asked. It is possible they were just describing crude oil.

Question 6

6 Which compound is an alkane?

A C_6H_8

B C_7H_{12}

C C_8H_{16}

D C_9H_{20}

Your answer ☐ **[1]**

Question 7

7 Sulfur dioxide, SO_2, reacts with oxygen, O_2, to make sulfur trioxide, SO_3, to form a dynamic equilibrium.

$2SO_2 + O_2 \rightleftharpoons 2SO_3$

Which statement describes the reaction at equilibrium?

A Rate of forward reaction < rate of backward reaction

B Rate of forward reaction > rate of backward reaction

C Rate of forward reaction = rate of backward reaction

D Rate of forward reaction ~ rate of backward reaction

Your answer ☐ **[1]**

Question 8

8 The equation shows the extraction of iron, Fe, from an oxide of iron, **X**, using carbon, C.

$2\mathbf{X} + 3C \rightarrow 4Fe + 3CO_2$

What is the formula of **X**?

A FeO

B Fe_2O

C Fe_2O_3

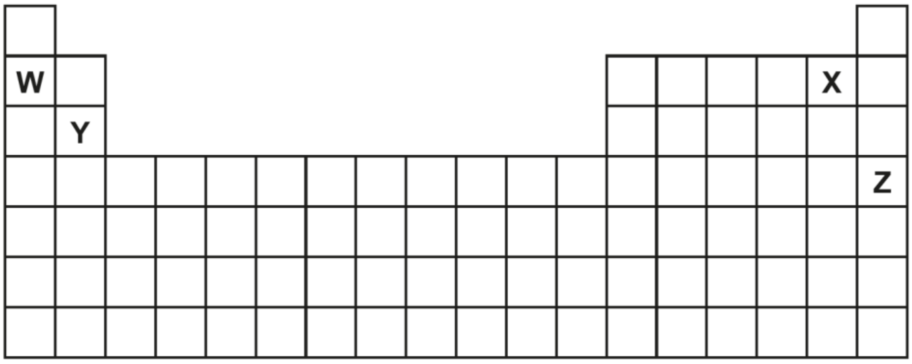
D Fe_4O_6

Your answer [1]

B was a common incorrect answer here. The candidates knew they needed to balance 4 x Fe but had not realised they needed to also balance 6 x O.

Question 9

9 Look at the diagram of the Periodic Table.



Which elements react with dilute hydrochloric acid to form **positive** ions?

A **W** and **X**

B **W** and **Y**

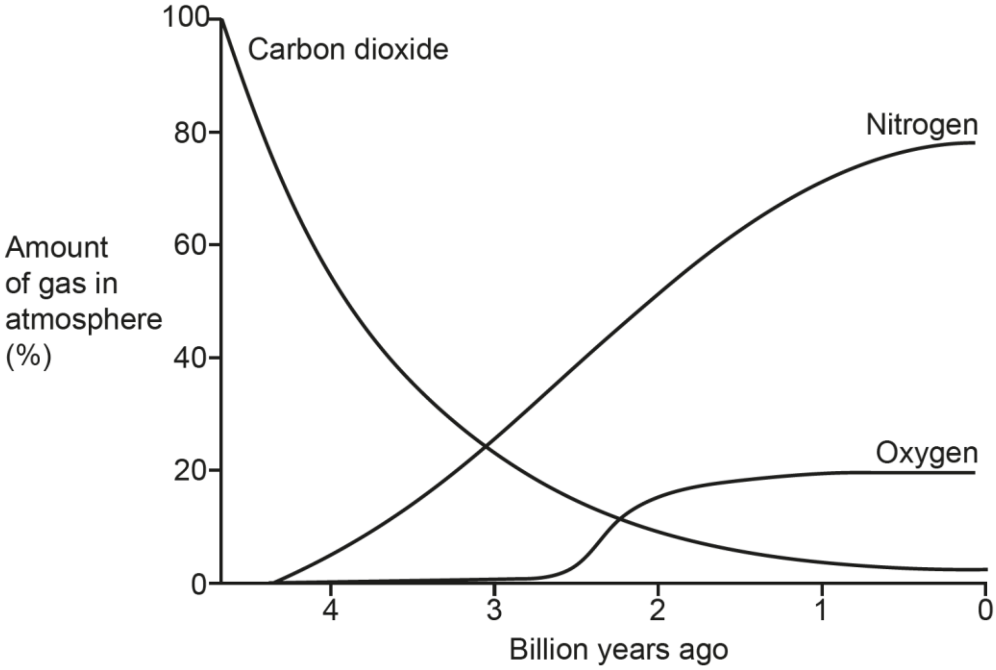
C **X** and **Y**

D **X** and **Z**

Your answer [1]

Question 10

10 The graph shows how the amounts of carbon dioxide, nitrogen and oxygen in the Earth's early atmosphere may have changed over time.



How many years ago does the graph suggest that photosynthesis started to happen?

A 1.2–1.6 billion years ago

B 2.2–2.6 billion years ago

C 3.2–3.6 billion years ago

D 4.0–4.4 billion years ago

Your answer **[1]**

Most candidates mistakenly choose B here. They could see the large increase in oxygen so showed an understanding that photosynthesis would produce oxygen. However, if they had read the question more carefully, they would have noted that they needed to identify when photosynthesis started. Therefore C was the correct answer.

Section B overview

It was good to see many candidates attempt most items. This is excellent exam technique. Most candidates did well on Question 11. They also understood distillation and most gained some marks for Question 12. In some cases marks were lost because of incorrect use or imprecise use of scientific terms which meant they did not fully answer the questions. Question 13 (a) was answered well but candidates struggled with b and c. More practice of drawing and using tangents would really help with a 13 (c) style question. However, most showed good exam technique in showing their working.

It was clear that candidates were familiar with electrolysis. They were sometimes let down on Question 14 by confusion between scientific terms such as anode and cathode. They also struggled to write correct half equations.

Many candidates had good knowledge of group 0 elements and so gained at least a couple of marks for Question 15.

Question 16 was difficult for most candidates, with few gaining any marks. Candidates need more practice interpreting and using reversible equations and Le Chatelier's principle.

Question 11 (a)

11 This question is about the Group 7 elements.

Table 11.1 shows some information about the Group 7 elements.

Table 11.1

Element	Molecular formula	Appearance at room temperature	Size of molecule (pm)	Boiling point (°C)
Fluorine	F_2	pale-yellow gas	128	–188
Chlorine	Cl_2	green gas	204	–34
Bromine	Br_2	orange-brown liquid	240	
Iodine	I_2	grey-black solid	278	184
Astatine	At_2	....	300	350

(a) Complete the table by predicting the appearance of astatine at room temperature.

Write your answer in the box in **Table 11.1**. **[1]**

Where candidates read the data carefully, they were able to spot the trend and so scored. Many realised the colour would be black/dark colour but some did not include "solid" in their response.

Question 11 (b)

(b) The sizes of the molecules are measured in picometres (pm).

$$1 \text{ picometre} = \frac{1}{1\,000\,000\,000\,000} \text{ metre}$$

What is the size of a fluorine molecule in metres (m)?

Tick (✓) **one** box.

1.28×10^{-12} m ☐

1.28×10^{-10} m ☐

1.28×10^{10} m ☐

1.28×10^{12} m ☐

[1]

Most candidates scored here but A was a common wrong answer.

Question 11 (c)

(c) Which element has a molecule that is **closest** to twice the size of a molecule of fluorine?

Tick (✓) **one** box.

Chlorine ☐ Bromine ☐ Iodine ☐ Astatine ☐

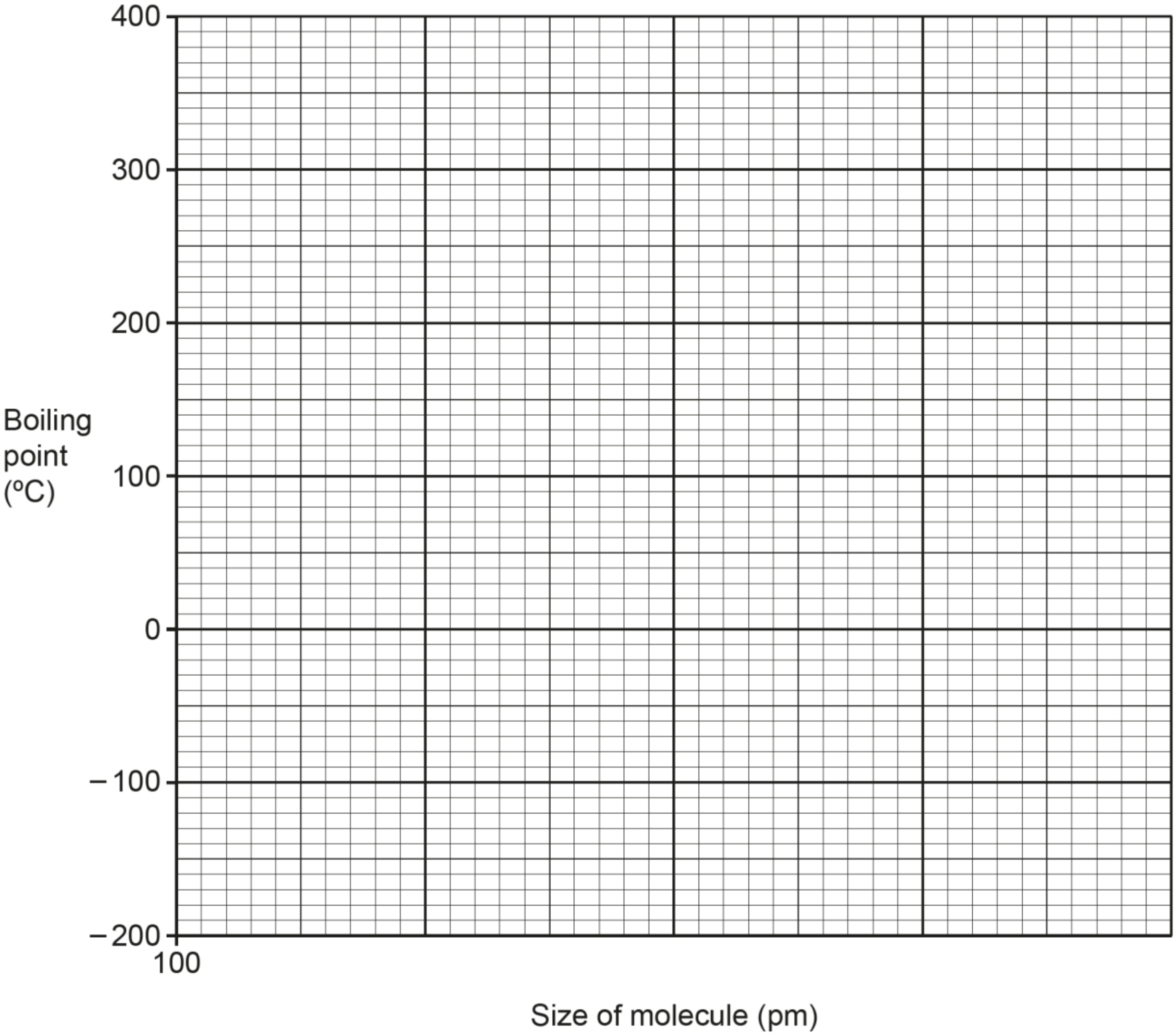
[1]

Candidates generally used the information in the table to successfully choose Bromine as the correct response.

Question 11 (d) (i)

(d) (i) Use **Table 11.1** to complete the x axis and plot a **line graph** of the boiling points of fluorine, chlorine, iodine and astatine against the size of their molecules.

Draw a line of best fit.



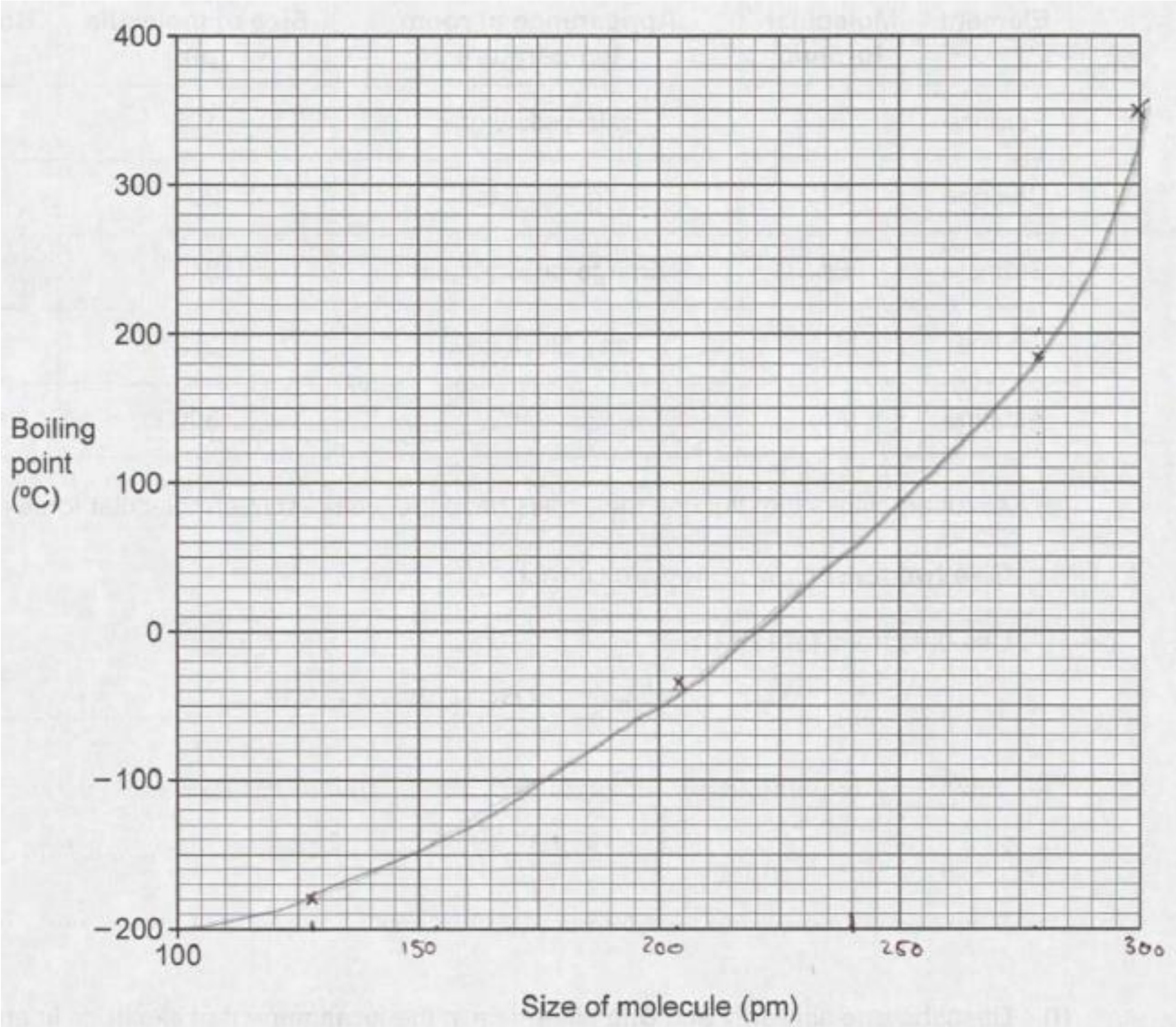
[4]

Assessment for learning

Most candidates scored at least 1 mark here. Most scored M1 (x axis) and at least 1 plotting point. The standard of curves drawn was often poor, with many candidates opting for a straight line. It is important that candidates understand that a line of best fit can be a straight line or a curve. They need to make a sensible decision based on the plots

A few missed the 100 provided on x-axis and so started their axis at zero. Some did not use a scale and just labelled x-axis with names of halogens. In some cases they used very strange scales that made it difficult for them to plot, e.g. small squares =3 pm. The graph paper provided will always allow for a sensible scale that covers the majority of the graph paper.

Exemplar 1



This response shows some good practice. The candidate has chosen a sensible scale that fills the graph paper. The scale also makes it easy to plot the points. They have used crosses not dots for the plots. Crosses make it clear where the plot should be. Dots can get covered by the line and make them hard to mark. They have also drawn a smooth curve, with no breaks and no feathering. It is a thin line so it is clear it is going through the plots.

Question 11 (d) (ii)

(ii) Use your graph to predict the boiling point of bromine.

Boiling point of bromine = ... °C **[1]**

Many were able to read off the graph correctly but some struggled to correctly select 240 on the x-axis. Some candidates just ignored the line drawn and selected a value anywhere along the '240 vertical line'. A few candidates perceived a trend based on the plotting of points and inserted a point for Br_2 – even if this was well away from the straight line drawn

A common error seen for those using all of the x-axis was miss reading the 240 value and selecting the 245 value.

The candidates that drew interpolation lines were most likely to gain this mark.

Question 11 (c)

Table 11.1 is repeated below.

Table 11.1

Element	Molecular formula	Appearance at room temperature	Size of molecule (pm)	Boiling point (°C)
Fluorine	F_2	pale-yellow gas	128	–188
Chlorine	Cl_2	green gas	204	–34
Bromine	Br_2	orange-brown liquid	240	
Iodine	I_2	grey-black solid	278	184
Astatine	At_2		300	350

(e) A student thinks that fluorine molecules have the **weakest** intermolecular forces.

Give **two** reasons why they are correct.

Use data from **Table 11.1**.

1 ....

....

2 ....

....
[2]

More able candidates tended to score both marks making use of the data available. The main error was where candidates did not use a comparative statement i.e. "lowest/smallest …"

Question 11 (f)

(f) Describe **one** similarity and **one** difference in the arrangement of electrons in **atoms** of fluorine and chlorine.

Similarity ....

....

Difference ....

.... **[2]**

Misconception

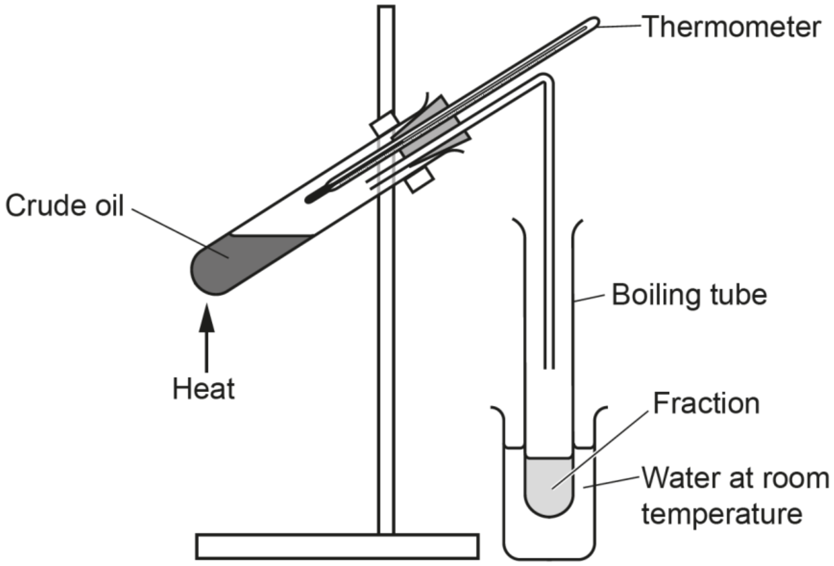
? It is important to read the question carefully. This question is about the arrangement of electrons. Several candidates tried to answer in terms of reactivity or how the atoms form bonds, which would not gain the mark.

Most candidates scored at least 1 mark for "7 electrons in the outer shell". Less successful candidates often stopped at his point and produced answers relating to the nature of the halogens rather than electron configuration. Some just quoted total number of electrons or boiling points, etc. A quite common error for M1 was "they both need 1 extra electron to fill outer shell" rather than describing the number of electrons in the outer shell

Question 12 (a)

12 The processing of crude oil by the petrochemical industry can be shown by different experiments.

The diagram shows how crude oil can be separated into its fractions.



The crude oil is heated. Different fractions are collected at different temperatures.

(a) What is the name of this separation technique?

.... **[1]**

Most candidates recognised this equipment and correctly scored here with either "fractional distillation (COMMON) or "distillation". A few candidates produced answers including 'fracking', 'cracking' 'fractionating' and even 'electrolysis'.

Question 12 (b)

(b) Explain how a fraction is separated and collected in the experiment.

....

....

....

.... **[2]**

Misconception

?

This is an 'Explain how' not an 'Explain why' question. Candidates needed to answer in terms of what is done to separate and collect the fractions not in terms of why it is possible to separate them.

Many candidates started to link the boiling points of fractions to the separation process but did not address the requirements of the question. Those that realised the question referred to the typical lab equipment had a much better chance of scoring. Too many just produced an answer relating to the industrial apparatus covered in the course. They reproduced the idea of "fractions have different boiling points ….". Some more able candidates did not score because they related the boiling point to hydrocarbon chain length and order of collection. This took up space, was good science but still did not score.

Exemplar 2

The crude oil is heated and the graction is evaporated. It then condenses into the boiling tube and is kept in liquid gorm by the room temperature water.

Exemplar 2 shows a good response that meets the mark scheme. The mark scheme needs the idea of evaporating the fraction and them condensing it. Exemplar 2 gains these marks in the first 2 lines.

Question 12 (c)

(c) A fraction with a boiling point of about 10 °C is **not** collected in the experiment.

How could the experiment be improved so this fraction is collected?

....

.... **[1]**

This was a high-level question and few scored here. Those that did understood they needed to use ice water to condense the fraction.

Question 12 (d)

(d) The table shows the temperatures at which four different fractions are collected.

Fraction	Temperature fraction collected (°C)
A	below 100
B	100–150
C	150–200
D	200–250

Which statements about the fractions are **true**, and which are **false**?

Tick (✓) **one** box in each row.

	True	False
The fractions consist mostly of compounds which are hydrocarbons.		
Fraction **C** is collected before Fraction **D**.		
The molecules in Fraction **A** are larger than the molecules in Fraction **B**.		

[2]

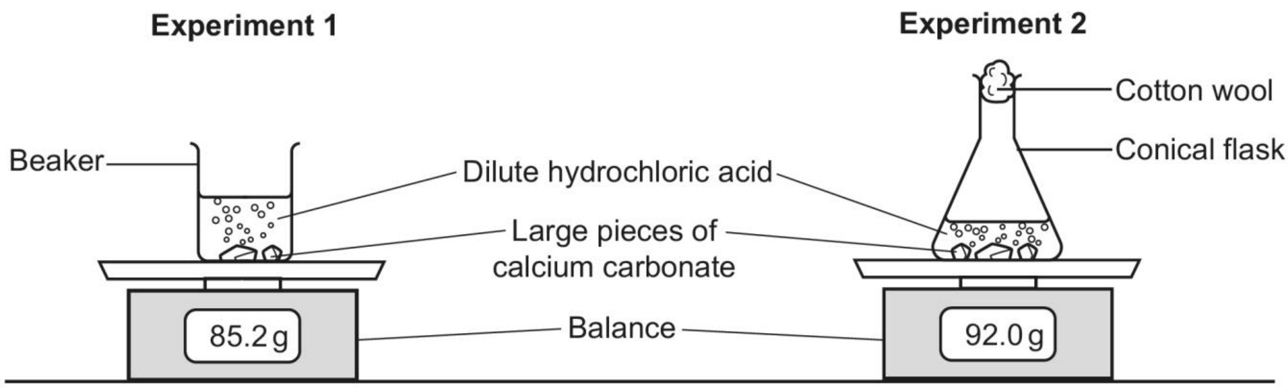
Most candidates gained at least 1 mark here. They have a good understanding of fractional distillation.

Question 13 (a)

13 A student investigates the rate of reaction between large pieces of calcium carbonate and dilute hydrochloric acid.

Fig. 13.1 shows two different experiments the student could use.
In both experiments the mass decreases as the reaction progresses.

Fig. 13.1



(a) The equation shows the reaction between calcium carbonate and hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Use this equation to explain why the mass **decreases** as the reaction progresses.

....

....

....

.... **[2]**

This question was generally answered well, with many candidates scoring at least 1 mark. Many linked the loss of mass to a gas, or CO_2. More able candidates realised that the gas escaped while less successful responses either missed that issue or referred to "gases have less mass" or "gas is less dense" and therefore "it weighs less".

Misconception

Many candidates thought that the products weigh less as they are gases and gases are less dense. They did not understand that the mass of the products must equal the mass of the reactants and it was just the loss of gas that made the mass measurement decrease.

Question 13 (b)

(b) The student decides to use **Experiment 2** because they think it will produce more accurate results than **Experiment 1**.

Explain why the student is correct.

....

....

....

.... **[2]**

Very few candidates scored here. If they did, they gained the mark for the cotton wool preventing acid from escaping. Almost all candidates thought the cotton wool prevented the gas from escaping and that this made it a better result.

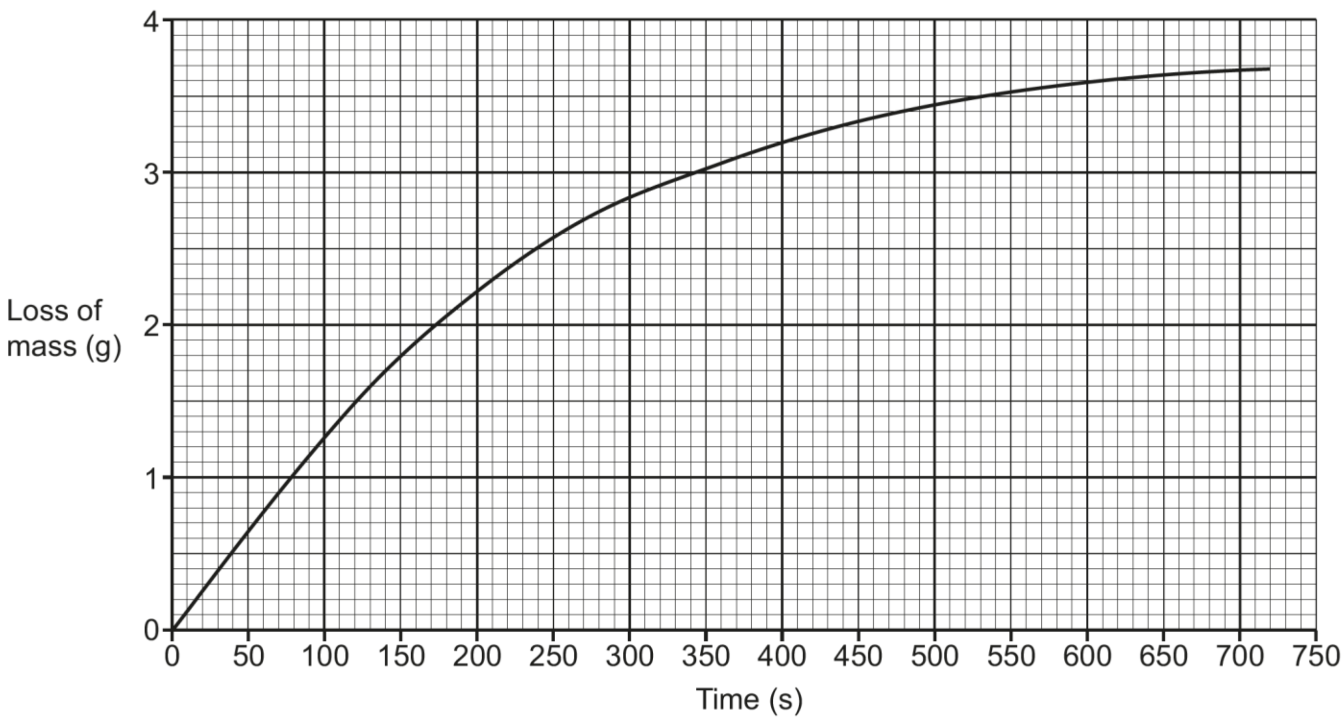
Assessment for learning

Whenever students carry out a practical or watch a practical demonstration it is useful to ask questions about the techniques, procedures and equipment used. For example, a discussion about why cotton wool is used in this experiment would help students understand how to improve accuracy as well as why the mass loss helps measure rate.

Question 13 (c)

(c) **Fig. 13.2** shows the graph of the student's results.

Fig. 13.2



The rate of reaction can be found by using a tangent.

Draw a tangent at 300 seconds on the graph in **Fig. 13.2**.

Use the tangent to calculate the rate of reaction at 300 seconds.

Give your answer to **2** significant figures.

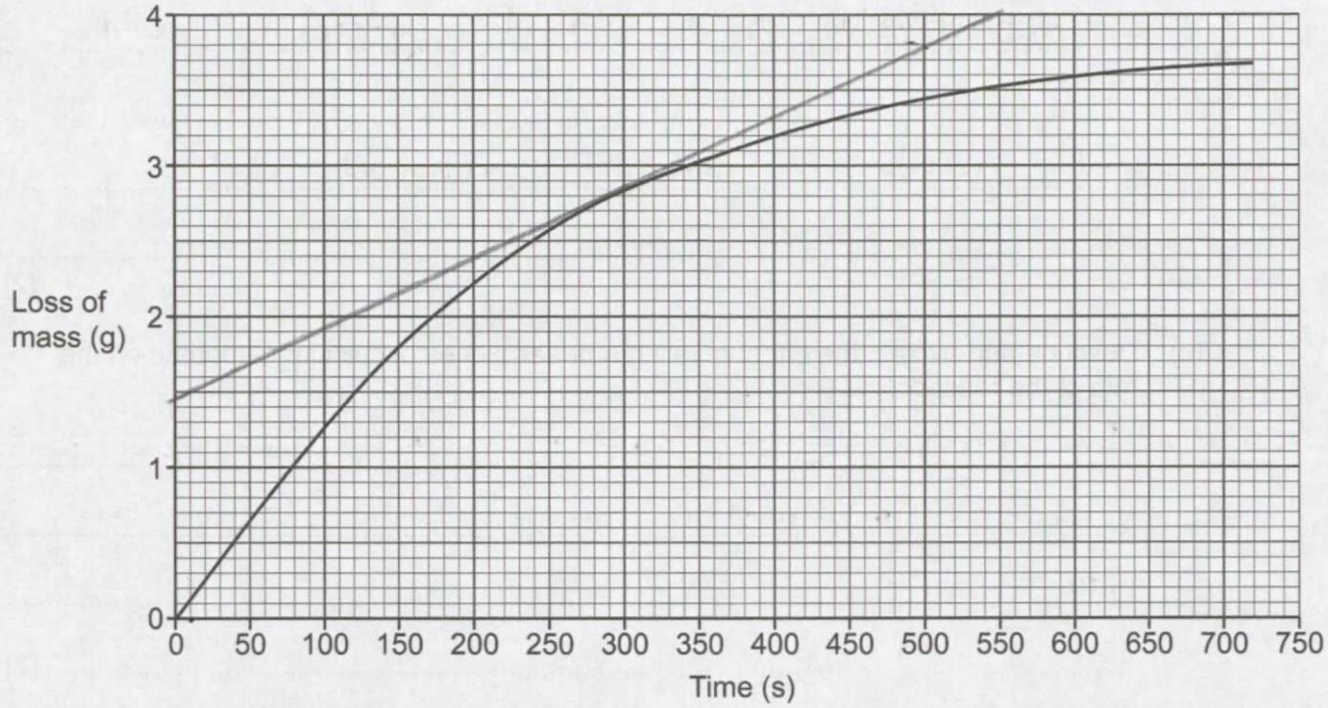
Rate of reaction at 300 seconds = ... g/s **[4]**

Few candidates drew a tangent and, in some cases, even though they drew a tangent they used it incorrectly. Those that drew longer tangents made it easier for themselves to choose appropriate numbers and therefore were more likely to gain full marks.

Many incorrectly drew interpolation lines at 2.8 and 300 and then divided 2.8/300 which was a common response. Many did not show how they chose the numbers they used.

Most candidates knew to divide the increase in y by the increase in x and so gained a mark here. Converting the answer to 2 significant figures was not understood by less successful candidates who often left their answer to several significant figures or used a recurring dot over the final figure and so did not score the final mark. It is also possible that some candidates had not read the question fully and so had missed the instruction to convert to 2 significant figures.
it was good to see most candidates show their working which meant the examiners were able to give some marks for correct techniques.

Exemplar 3



The rate of reaction can be found by using a tangent.

Draw a tangent at 300 seconds on the graph in **Fig. 13.2**.

Use the tangent to calculate the rate of reaction at 300 seconds.

Give your answer to **2** significant figures.

(300, 2.85)
(500, 3.8)

~~(10, 1.5)~~
~~(550, 4)~~

~~550 − 10 / 4 − 1.5 = 540 / 2.5~~

~~4 − 1.5 / 550 − 10~~ → ~~2.5 / 540~~ = ~~1 / 216~~

~~0.0.0.4.75~~
~~0.0047~~
~~0.0.0.4.629~~

(300, 2.85)
(500, 3.8) → 3.8 − 2.85 / 200 = 4.75×10^{-3} ~~0.004~~

Rate of reaction at 300 seconds = ~~0.0046~~ ~~216~~ 0.0047 g/s **[4]**

This is a response that gains all the mark points.

The tangent is drawn at 300. They have shown in brackets how they chose the numbers to divide. They have correctly divided these numbers and then converted their response to 2 significant figures.

The candidate has other working that they have crossed out as they have decided not to use it.

Question 13 (d) (i)

(d) The student repeats **Experiment 2** with **smaller** pieces of calcium carbonate to see how this changes the rate of the reaction.

(i) Describe **two** variables the student must keep the same in this experiment.

1 ....

....

2 ....

....

[2]

Most candidates gained at least 1 mark here. Some misunderstood variables and discussed the equipment which could not be given marks. Although we allowed a mark for 'amount' of acid, it is important that students get into the habit of using the correct terminology, 'volume'.

Misconception

Many candidates showed a misunderstanding between concentration and strength, with many suggesting keeping the pH of the acid the same.

Question 13 (d) (ii)

(ii) Describe and explain the effect of using **smaller** pieces of calcium carbonate on the rate of the reaction.

....

....

....

.... **[2]**

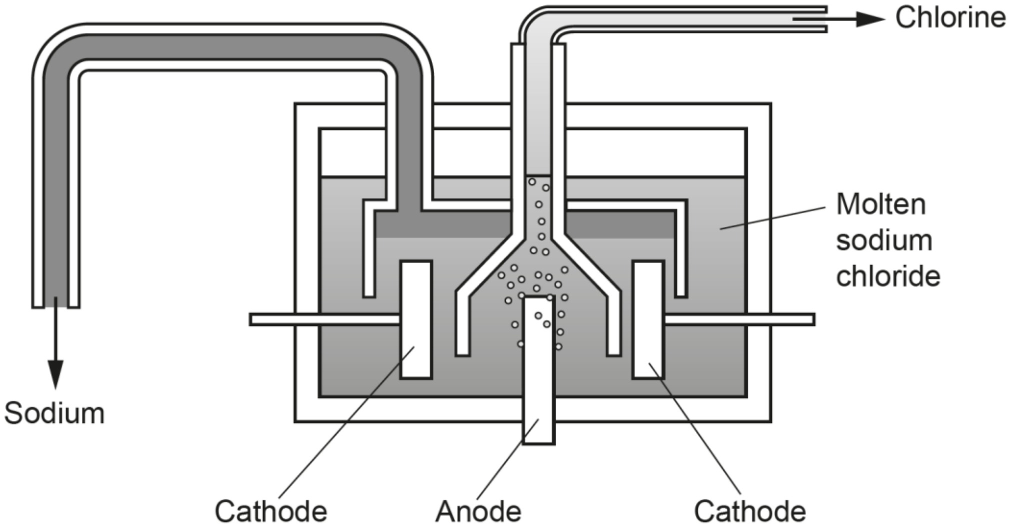
Many candidates scored both marks here relating an increase in surface area to rate. Many mentioned that there would be "more collisions" or "more successful collisions" but did not mention a "greater frequency of collisions" – this usually made little difference to the score since they had already linked surface area to rate. A quite common error was linking smaller size chips to less mass of $CaCO_3$.

Question 14*

14* Sodium is extracted from molten sodium chloride, NaC*l*, by electrolysis. Sodium produced by this process is expensive.

Sodium chloride is an ionic compound. It has a melting point of 801 °C.

The diagram shows the industrial electrolysis of molten sodium chloride.



Describe how the electrolysis of molten sodium chloride produces sodium and evaluate the process to explain why the sodium produced is expensive.

Use a balanced symbol equation and half-equations in your answer.

....

....

....

....

....

.... **[6]**

Nearly all candidates attempted this question and of those that did nearly all gained at least 1 mark.

Many candidates attempted to produce half equations. However, they were often incorrect or the wrong equations. They tried to give the equations to show how the ions were formed not how sodium and chlorine were formed, so even if they were correctly written they did not add to the response.

Confusion was common about whether electrons were gained or lost at electrodes with some candidates stating the exact opposite of what happens. Some related the need for electrolysis because sodium was more reactive than carbon – unfortunately this concept was not required and shows these candidates had not read the question carefully.

Many candidates did not link the expensive process to energy costs. Many candidates just repeated information from the question or diagram without expanding on the information and so gained no marks.

Marks were often given where there was a good understanding of charges on ions and movement to which electrodes.

Exemplar 4

Sodium chloride is ~~pro~~ heated to a temperature above 801 °C, this form it into a liquid meaning that it can ~~be~~ ~~ele~~ conduct electricity. The sodium ~~is~~ ion is attracted to the negative cathode, where it gains electrons to form sodium ($Na^{+1} + e^- \rightarrow Na$). Chlorine is attracted to the ~~an~~ positive anode where it loses an electron to form Chlorine ($2Cl^{-1} \rightarrow Cl_2 + 2e^-$). This means that the Sodium chloride is separated into Sodium and Chlorine ($2NaCl \rightarrow 2Na + Cl_2$). The Sodium produced is expensive because a lot of energy is required to ~~ele~~ melt Sodium chloride because of its high melting point and it takes a lot of energy to separate the Compound. **[6]**

This response shows a Level 3 answer.

The first sentence shows an understanding that the sodium chloride needs to be heated which is slightly more than is given in the question. However, they have not linked this to cost at this point. They then describe the charge of the ions and which electrode they move to. They also give correct half equations for the reactions at the electrodes. The final 4 lines explains why it is an expensive process.

There are a few minor errors, e.g. the candidate mistakenly says the chlorine is attracted to the positive anode to form chorine, but they clearly understand what is happening. There is evidence for this in the half equations given. So, this is a good Level 3 response.

Question 15 (a)

15 For many years it was thought that the Group 0 elements were completely unreactive.

However, more recently, scientists have been able to react some of the Group 0 elements with fluorine.

The table shows information about some of the compounds Group 0 elements make with fluorine.

Group 0 element	**Year compound first made**	**Formula of compound**
Helium	no compounds yet made	
Neon	no compounds yet made	
Argon	2003	ArF_2
Krypton	1963	KrF_2
Xenon	1962	XeF_2

(a) Give a reason why the Group 0 elements are usually described as unreactive.

....

.... **[1]**

Most candidates gained this mark. Some thought Group 0 elements have no electrons in the other shell.

Question 15 (b)

(b) Give a reason why scientists have used **fluorine** to make compounds of the Group 0 elements.

....

.... **[1]**

Many understood that fluorine was very reactive for the mark. However, some did not suggest it was 'very reactive' – the comparative idea was missing and so did not gain the mark.

Question 15 (c) (i)

(c) Xenon difluoride, XeF_2, is a solid at room temperature. It melts at 129 °C and boils at 155 °C. It does **not** conduct electricity in any state.

(i) Suggest the structure of xenon difluoride, XeF_2.

.... **[1]**

Most candidates attempted this question. However, hardly any mentioned 'simple molecule' or 'simple covalent'. Common errors included 'giant molecule' or 'ionic' (and versions of ionic). Some appeared to not understand what was required by the question and gave responses relating to boiling points, electron structure, state, reactivity of other unrelated ideas. This is a structure that is in the specification. It is essential all types of structures in the specification are covered by students.

Question 15 (c) (ii)

(ii) Give **two** reasons for your answer in **(c)(i)**.

1 ....

....

2 ....

....
[2]

Even though almost no student knew what type of structure this was, it was good to see most use the information in the stem of 15ci to answer this question. This is excellent technique and gained most candidates at least 1 mark. Many gained a mark for a description of a covalent bond or for the idea that there are no delocalised electrons.

Common errors included believing the compound had high melting and boiling points. Some felt that the small gap between the two values was the indicative fact. Others stated that it did not conduct electricity but as this is just a repeat of the stem did not gain a mark.

Question 15 (d)

(d) Describe how the trend in reactivity of the Group 0 elements is linked to the size of the atoms.

....

.... **[1]**

Many candidates gained this mark. Those that did not, had not read the question carefully and so linked reactivity or size to position in the group rather than to each other. Some showed a good understanding of why i.e. the idea of further away an electron is from the nucleus the easier it reacts but sometimes did not answer the question asked.

Question 16 (a)

16 Ethanol, C_2H_5OH, can be made by reacting ethene, C_2H_4, with steam, H_2O.

$$C_2H_4(g) + H_2O(g) \rightleftharpoons C_2H_5OH(g)$$

The forward reaction is exothermic.

(a) State Le Chatelier's principle.

....

....

....

.... **[2]**

It was good to see candidates attempt this question. Question 16 was aimed at the most able and few gained any marks throughout.

Many showed that they did not understand the concept of equilibria.

Common incorrect answers included candidates referring to there always being an exothermic reaction (often the forward reaction) and an endothermic reaction

or

rate of forward reaction = rate of back reaction

Some candidates gained marks by describing what happens in a reaction at equilibrium if pressure, temperature or concentration was changed. This showed a good understanding.

Question 16 (b) (i)

(b) **(i)** As the temperature of the reaction is **increased** does the amount of ethanol decrease, increase or stay the same?

.... **[1]**

Question 16 (b) (ii)

(ii) Explain your answer to **(b)(i)**.

....

....

....

.... **[2]**

Some candidates were able to gain marks for 16bii even if they gave an incorrect answer to 16bi.

Most gained a mark for equilibrium moving to the endothermic side. Very few explained that this was to decrease the temperature.

Misconception

Many did not read the question carefully enough or did not understand the question. They tried to answer in terms of rate and so scored zero. If they answered in terms of rate they nearly always gave 'stays the same' as the answer to 16bi.

Question 16 (c) (i)

(c) **(i)** As the pressure of the reaction is **increased** does the amount of ethanol decrease, increase or stay the same?

.... **[1]**

Question 16 (c) (ii)

(ii) Explain your answer to **(c)(i)**.

....

....

....

.... **[2]**

Some candidates were able to gain marks for 16cii even if they gave an incorrect answer to 16ci.

Most gained a mark for equilibrium moving to the forward reaction. Very few explained that this was to decrease the pressure.

Copyright information

Question 1 – Rate of reaction graphs.

Question 3 – Diagram of apparatus

Question 4 – Greenhouse effect processes

Question 5 – Crude oil fractionating column sourced from OCR Paper J248/02 June 2020.

Question 10 - Graphs of gasses in the early atmosphere

Question 12 – Diagram of apparatus for processing of crude oil experiment

Question 13 - Fig. 13.1 Two different experiments to investigate the rate of reaction

Question 14 - Diagram of industrial process

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